National Institute of Environmental Health Sciences

Strong increases in flood frequency and discharge of the River Meuse over the late Holocene: Impacts of long-term anthropogenic land use change and climate variability

Author(s): Ward PJ, Renssen H, Aerts J, van Balen RT, Vandenberghe J
Year: 2008
Journal: Hydrology and Earth System Sciences. 12 (1): 159-175

Abstract:

In recent years the frequency of high-flow events on the Meuse (northwest Europe) has been relatively great, and flooding has become a major research theme. To date, research has focused on observed discharge records of the last century and simulations of the coming century. However, it is difficult to delineate changes caused by human activities (land use change and greenhouse gas emissions) and natural fluctuations on these timescales. To address this problem we coupled a climate model (ECBilt-CLIO-VECODE) and a hydrological model (STREAM) to simulate daily Meuse discharge in two time-slices: 4000-3000 BP (natural situation), and 1000-2000 AD (includes anthropogenic influence). For 4000-3000 BP the basin is assumed to be almost fully forested; for 1000-2000 AD we reconstructed land use based on historical sources. For 1000-2000 AD the simulated mean annual discharge (260.9 m(3) s(-1)) is significantly higher than for 4000-3000 BP (244.8 m(3) s(-1)), and the frequency of large high-flow events (discharge >3000 m(3) s(-1)) is higher (recurrence time decreases from 77 to 65 years). On a millennial timescale almost all of this increase can be ascribed to land use changes (especially deforestation); the effects of climatic change are insignificant. For the 20th Century, the simulated mean discharge (270.0 m(3) s(-1)) is higher than in any other century studied, and is ca. 2.5% higher than in the 19th Century (despite an increase in evapotranspiration). Furthermore, the recurrence time of large high-flow events is almost twice as short as under natural conditions (recurrence time decreases from 77 to 40 years). On this timescale climate change (strong increase in annual and winter precipitation) overwhelmed land use change as the dominant forcing mechanism.

Source: http://dx.doi.org/10.5194/hess-12-159-2008

Resource Description

Exposure :

weather or climate related pathway by which climate change affects health

Extreme Weather Event, Precipitation

Extreme Weather Event: Flooding

Geographic Feature:

resource focuses on specific type of geography

Freshwater

Geographic Location: ☑

resource focuses on specific location

Non-United States

Non-United States: Europe

European Region/Country: European Region

Other European Region: River Meuse

Health Impact: ☑

specification of health effect or disease related to climate change exposure

Health Outcome Unspecified

Intervention: ☑

strategy to prepare for or reduce the impact of climate change on health

A focus of content

Mitigation/Adaptation: ☑

mitigation or adaptation strategy is a focus of resource

Adaptation

Model/Methodology: ☑

type of model used or methodology development is a focus of resource

Exposure Change Prediction

Resource Type: ☑

format or standard characteristic of resource

Research Article

Timescale: ☑

time period studied

Historical

Vulnerability/Impact Assessment: ☑

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content